Application of Activity Based Model on Environmental Justice Analysis
- A Case Study of SCAG ABM

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Southern California Association of Governments (SCAG)
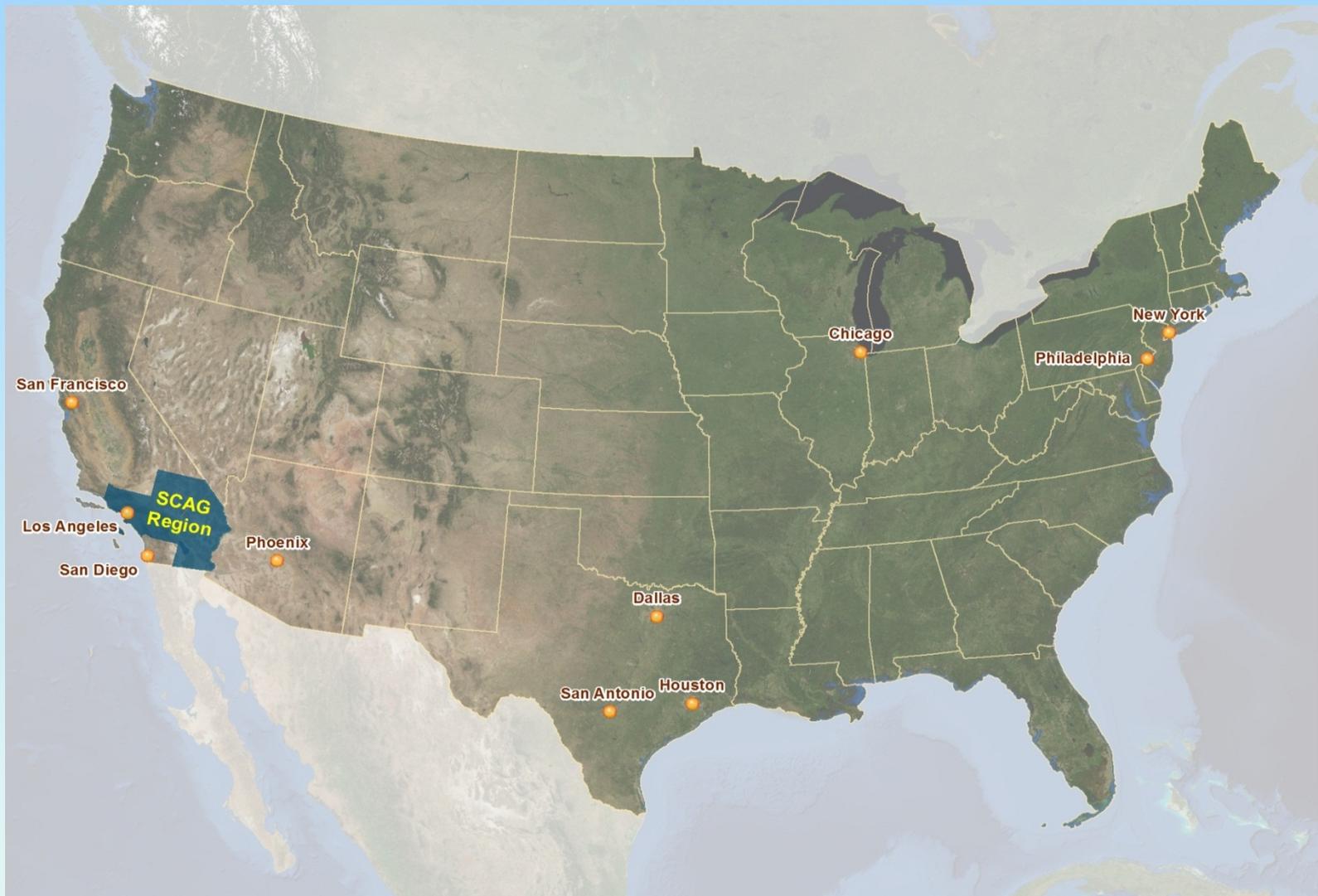
SCAG Quick Facts

Nation's largest Metropolitan Planning Organization (MPO)

6 counties and nearly 200 cities

18 million people within 38,000+ square miles

GDP in 2010: $910 Billion, 16th largest economy in the world

Nation's global gateway for trade

Concept of Environmental Justice (EJ)

- Based on Title VI of the Civil Rights Act of 1964.

- It's about equal and fair access to a healthy environment, with the goal of protecting underrepresented and poorer communities from incurring disproportionate negative environmental impacts.

- To avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on <u>minority populations and low-income populations</u>.

Environmental Justice in Transportation Planning Process

- Transportation agencies need to disclose to the public the benefits and burdens of proposed projects on minority populations and low-income communities.

- Environmental Justice is an important part of the planning process and must be considered in all phases of planning. This includes all public-involvement plans and activities, such as the development of Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS)

SCAG's EJ Analysis

Regional Transportation Plan (RTP)

- An RTP is a long-term plan of the region's transportation system for twenty years into the future. The plan identifies transportation needs and creates a framework for project priorities.

- Regional planning agencies need to conduct a system-wide, region-wide EJ analysis for the RTP.

- Since 1998, SCAG has conducted EJ analysis for the past five Regional Transportation Plans.

EJ Analysis for RTP/SCS

- Compare the RTP/SCS Plan scenario vs. Baseline scenario:
  - Plan: selected strategy to guide the region's future transportation planning
  - Baseline: "business as usual" - projects currently under construction or with available funding

- Core EJ Related Modeling Questions:
  - Are people worse or better off with the Plan?
  - Is there a disproportionate negative impact resulting from the Plan on any group?

EJ Characteristic of SCAG Region

- Southern California is vast and geographically distinct.
  - Has many geographically dispersed commercial and residential centers
  - Includes heavily urban and entirely rural areas
- Demographically, it is one of the most diverse and dynamic regions in the country.
  - It will become the first to see the total population of Hispanics exceed that of Non-Hispanic Whites
- The area is also quite economically diverse, and displays the extremes in household income.

SCAG EJ Performance Indicators

SCAG 2012 RTP/SCS EJ encompasses the following analysis:

- Revenue Sources in Terms of Tax Burdens by Income and Ethnicity
- **Share of Transportation System Usage**
- RTP/SCS Project Investment Share by Income and Ethnicity
- Impacts from Transportation Funding Based on VMT Fees
- **Distribution of Travel Time Savings and Distance Savings**
- Jobs-Housing Imbalance or Jobs-Housing Mismatch
- Accessibility to Employment and Services
- Accessibility to Parks
- Gentrification and Displacement
- Environmental Impact Analyses (Air, Health, Noise)
- Rail-Related Impacts

Transportation System Usage and Travel Time/Distance Saving

- Model: Regional Travel Demand Model
- Calculate:
  - Travel time by modes
  - Vehicle travel distance
- For: Baseline & Plan
- By: Following Groups:
  - Race/Ethnicity
  - Income/Poverty Level
  - Age
  - Gender

Current Approach – Trip Based Model

- Zone-zone Travel Data:
  - Person trips, travel time, and travel distance
  - By modes

- Demographic Groups:
  - SCAG socioeconomic data
  - Estimated and projected by TAZ

Issues of Current Methodologies

- Limitation of Trip-based Model on EJ Analysis:
  - Demographic characteristics are not traceable to travel pattern
  - All people living in the same TAZ are assumed to share the same level of mobility
- Activity-based Model can Better Address the Issues:
  - Model individual activity and travel
  - Individual socioeconomic attributes are used to explain travel behavior

Using SCAG's ABM for EJ Analysis

SCAG′s Activity-Based Model (ABM)

SCAG′s Activity-based model includes 3 core modules:

- PopGen: a synthetic population generator

- CEMSELTS: a disaggregated socioeconomic module, including work location and vehicle ownership/type sub-models

- CEMDAP: a daily activity and travel scheduling module

SCAG ABM Flowchart

Growth Forecasting

Socioeconomic Data in Zones

Attributes in Zones

Accessibility (aggregate)

Networks & Attributes

External Trips

Airports & Ports

All Other (commercial)

Population Synthesis

Long Term Choices

Daily Allocation

Daily Scheduling

Person Daily Tours & trips

Passenger & Highway and Transit

Origin – Destination Trip Interchange Matrices

Traffic & Transit Assignment

Post Processor

SCAG ABM Sequence and Modules
1. POPGEN

Social-Economic Data

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PopGen

CEMSELTS

CEMDAP

Traffic & Transit Assignment
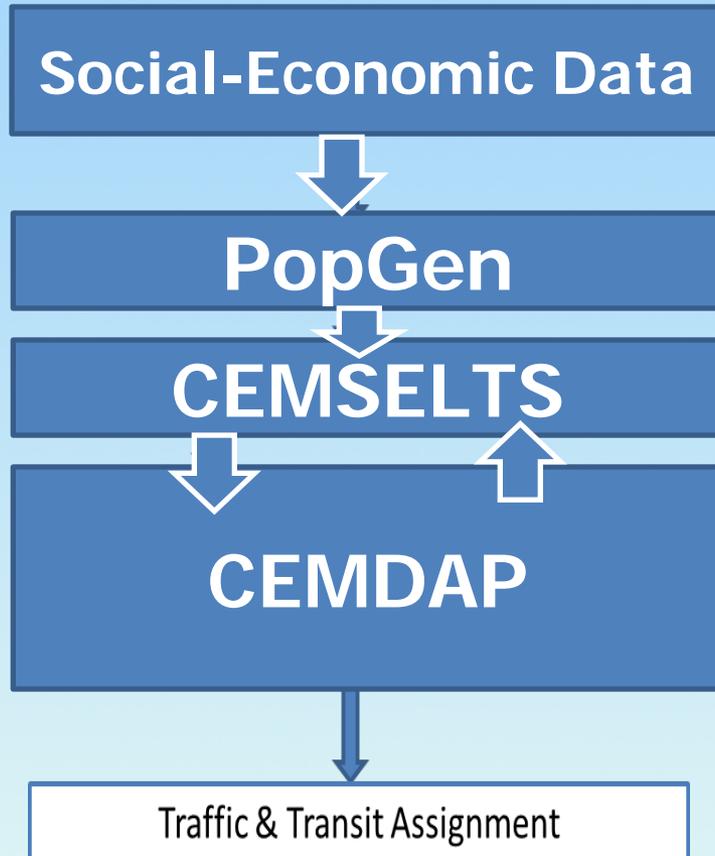
PopGen generates <u>basic socioeconomic attributes</u> for each of the region's 18+ million population.

EJ characteristics:
- Race/Ethnicity
- Age
- Gender

SCAG ABM Sequence and Modules
2. CEMSELTS

Social-Economic Data

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PopGen

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CEMSELTS

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CEMDAP

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Traffic & Transit Assignment
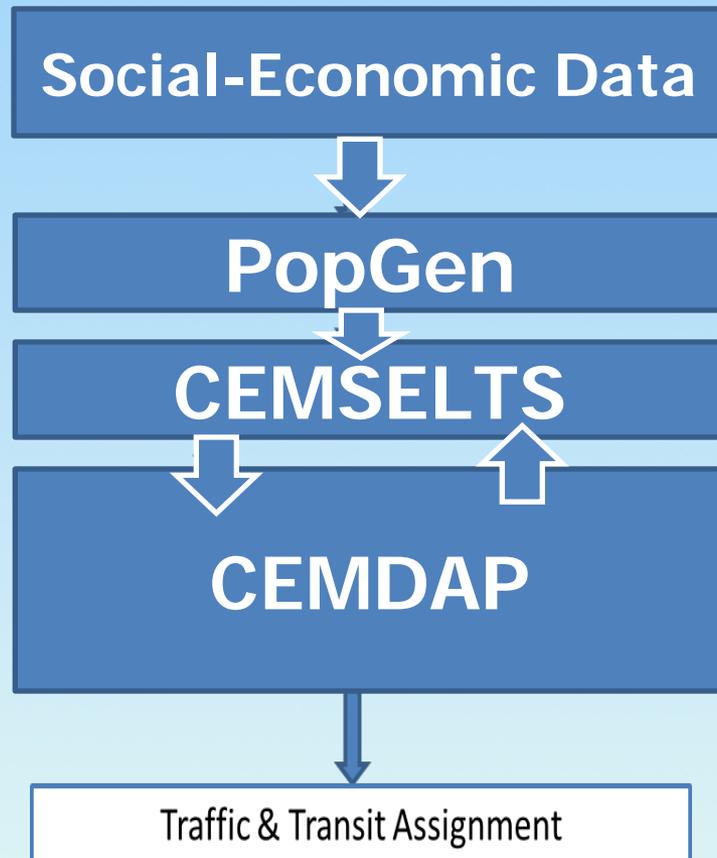
CEMSELTS* generates additional person and household <u>socioeconomic attributes</u> that feed to CEMDAP to simulate daily activity-travel patterns.

- Household Income is generated by a Household Income Model

** **C**omprehensive **E**conometric **M**icrosimulator of **S**ocio-economics, **L**and-use, and **T**ransportation **S**ystem*

SCAG ABM Sequence and Modules
3. CEMDAP

Social-Economic Data

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PopGen

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CEMSELTS

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CEMDAP

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Traffic & Transit Assignment
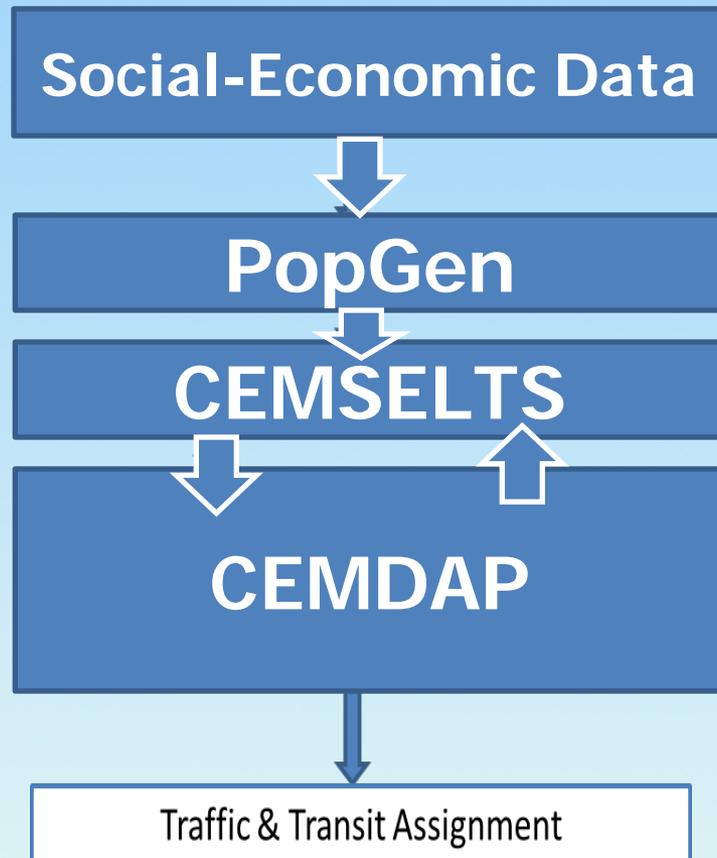
CEMDAP* is the core module that simulates <u>activity schedule and travel characteristics</u> for each individual.

- All EJ factors are used as input to CEMDAP model.

- Output shows individual's trip OD by modes

** **C**omprehensive **E**conometric **M**icrosimulator of **D**aily **A**ctivity-Travel **P**atterns*

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SCAG ABM Sequence and Modules
4. ASSIGNMENT

Social-Economic Data

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PopGen

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CEMSELTS

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CEMDAP

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Traffic & Transit Assignment
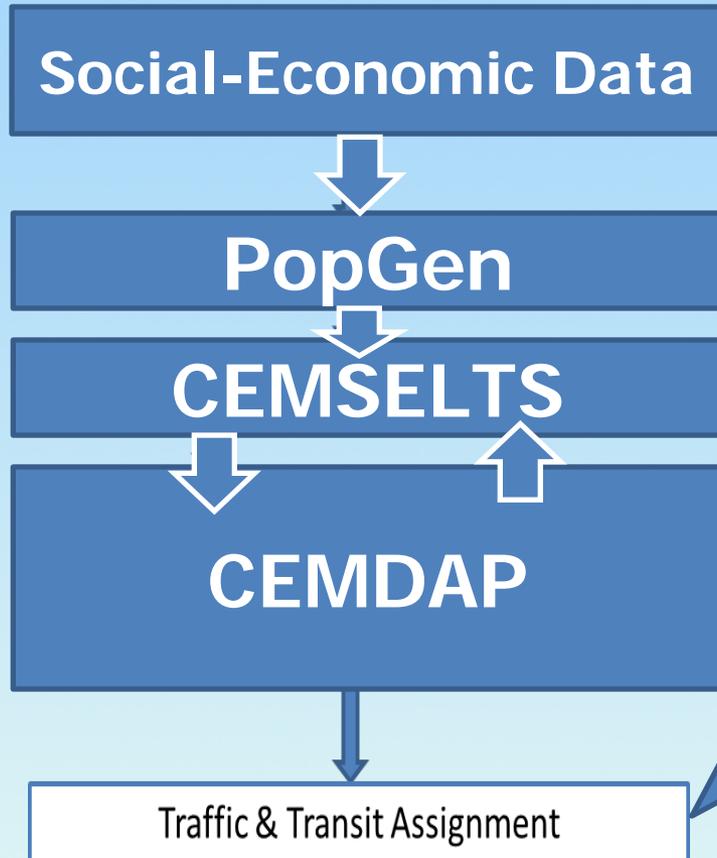
ASSIGNMENT output will create skim data that shows zone-zone travel distance and travel time.

- Merge OD skim with CEMDAP output to analyze accessibility and mobility by demographic groups.

Scenario Test

- EJ Test with SCAG ABM:
  - Using Stage 1 SCAG ABM
  - One set of SED Inputs
  - Two network scenarios: Baseline vs. Plan
- EJ Performance Indicators:
  - Person Auto Travel Time Saving (PHT)
  - Person Transit Travel Time Saving (PHT)
- By Race/Ethnicity, Household Income Quintile, Elderly/Non Elderly, Male/Female

Note: This test is performed post 12RTP/SCS analysis

Data Process

- **CEMSELTS: 5.7M Households; 17M Population**
  - Household ID, Person ID
  - Age, Gender, Race/Ethnicity, Household income
- **CAMDAP (Each Trips): 57 Million Trips**
  - Household ID, Person ID
  - TAZ ID for each trip OD
  - Mode use for each trip
- **SKIM: 16M OD Pairs**
  - Auto Travel Time and Transit Travel Time

Note: Use SAS to merge data and calculate the results

EJ Results
Baseline vs. Plan

Results – by Race/Ethnicity

Share of Auto PHT Reduction and Usage
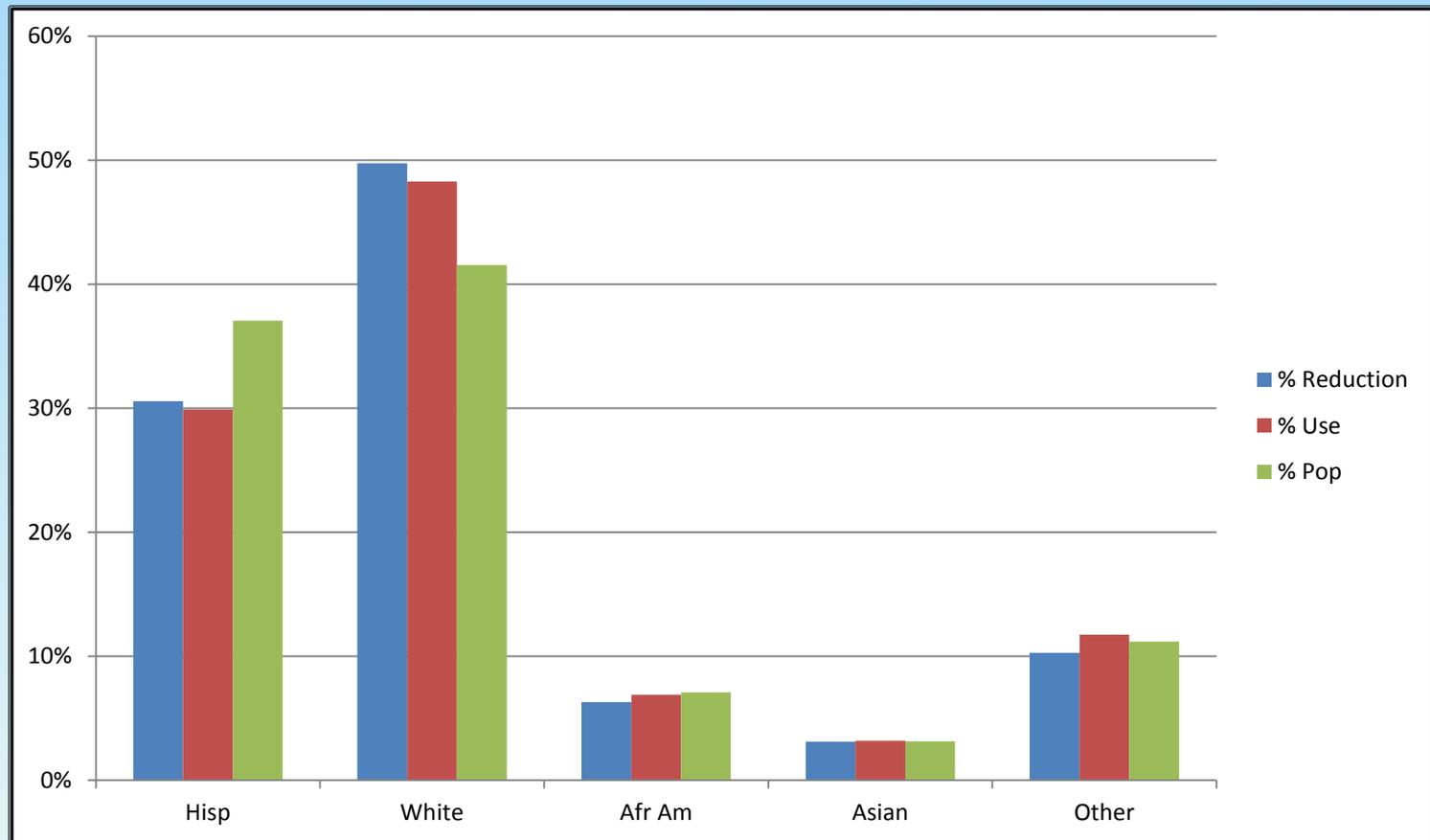
Results – by Household Income Quintile

Share of Auto PHT Reduction and Usage

Share of Auto PHT Reduction and Usage

Results – by Male/Female

Share of Auto PHT Reduction and Usage
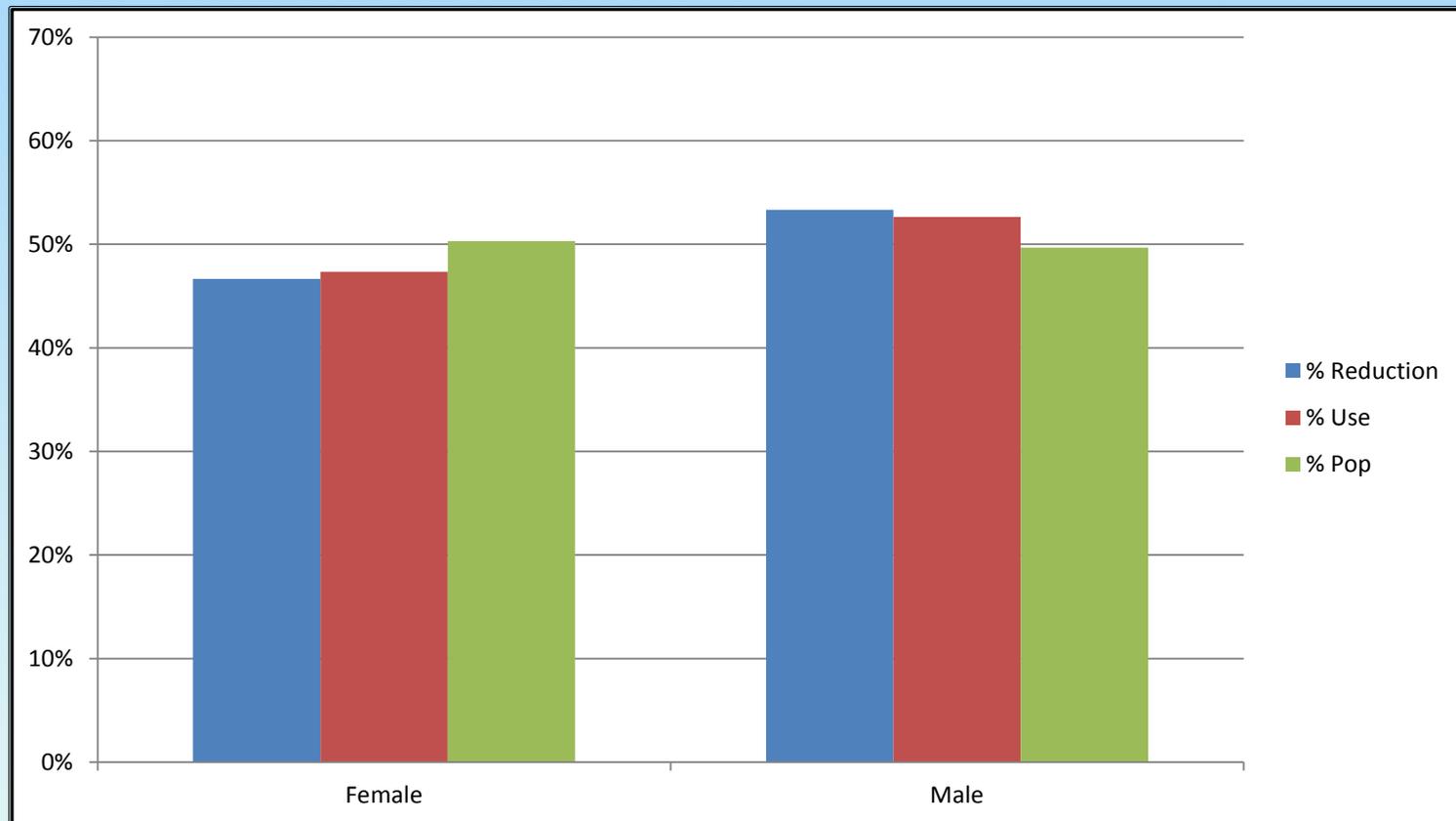
Results – by Race/Ethnicity

Share of Transit PHT Reduction and Usage
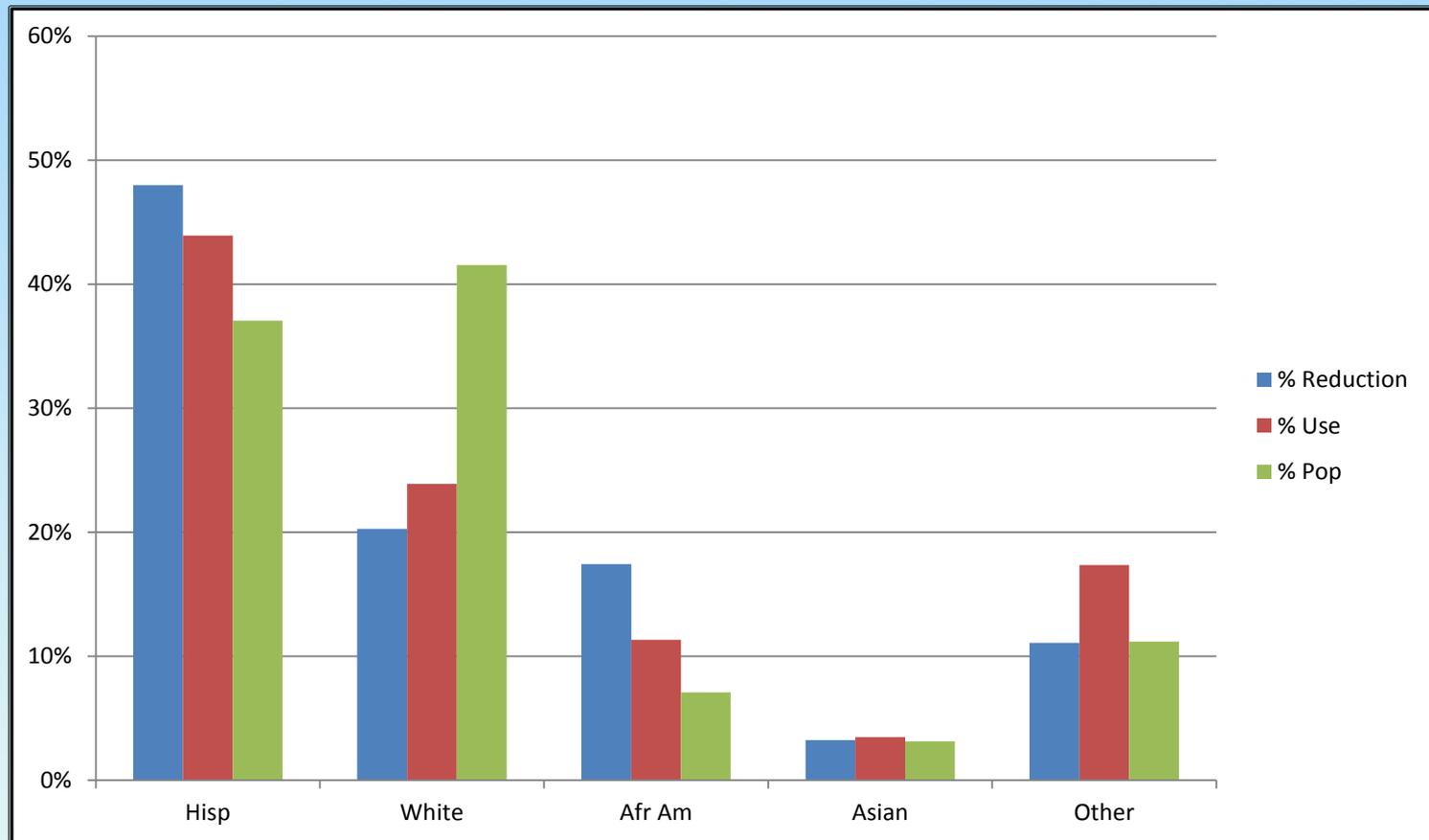
Results – by Household Income Quintile

Share of Transit PHT Reduction and Usage
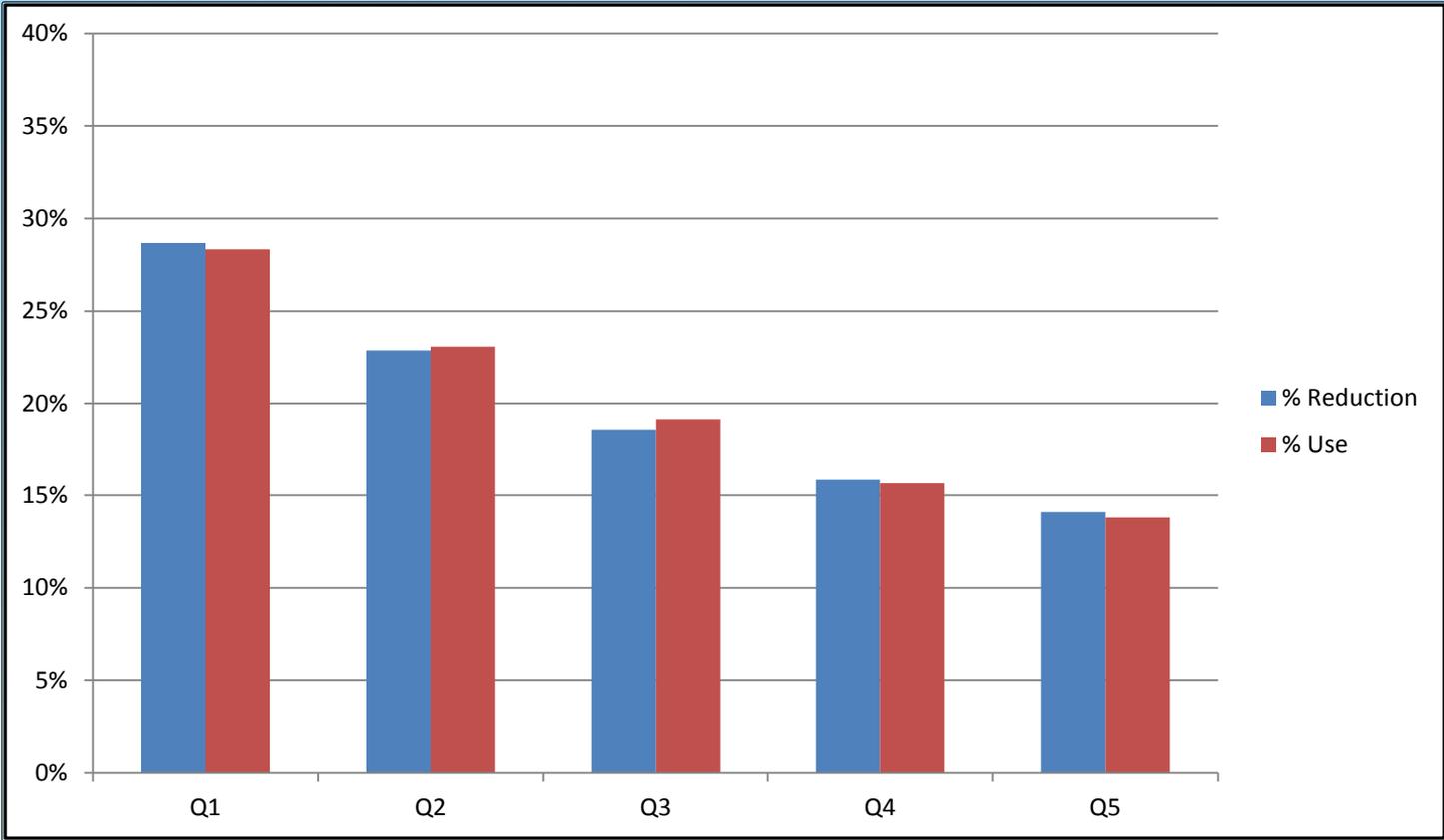
Results – by Elderly/Non Elderly

Share of Transit PHT Reduction and Usage
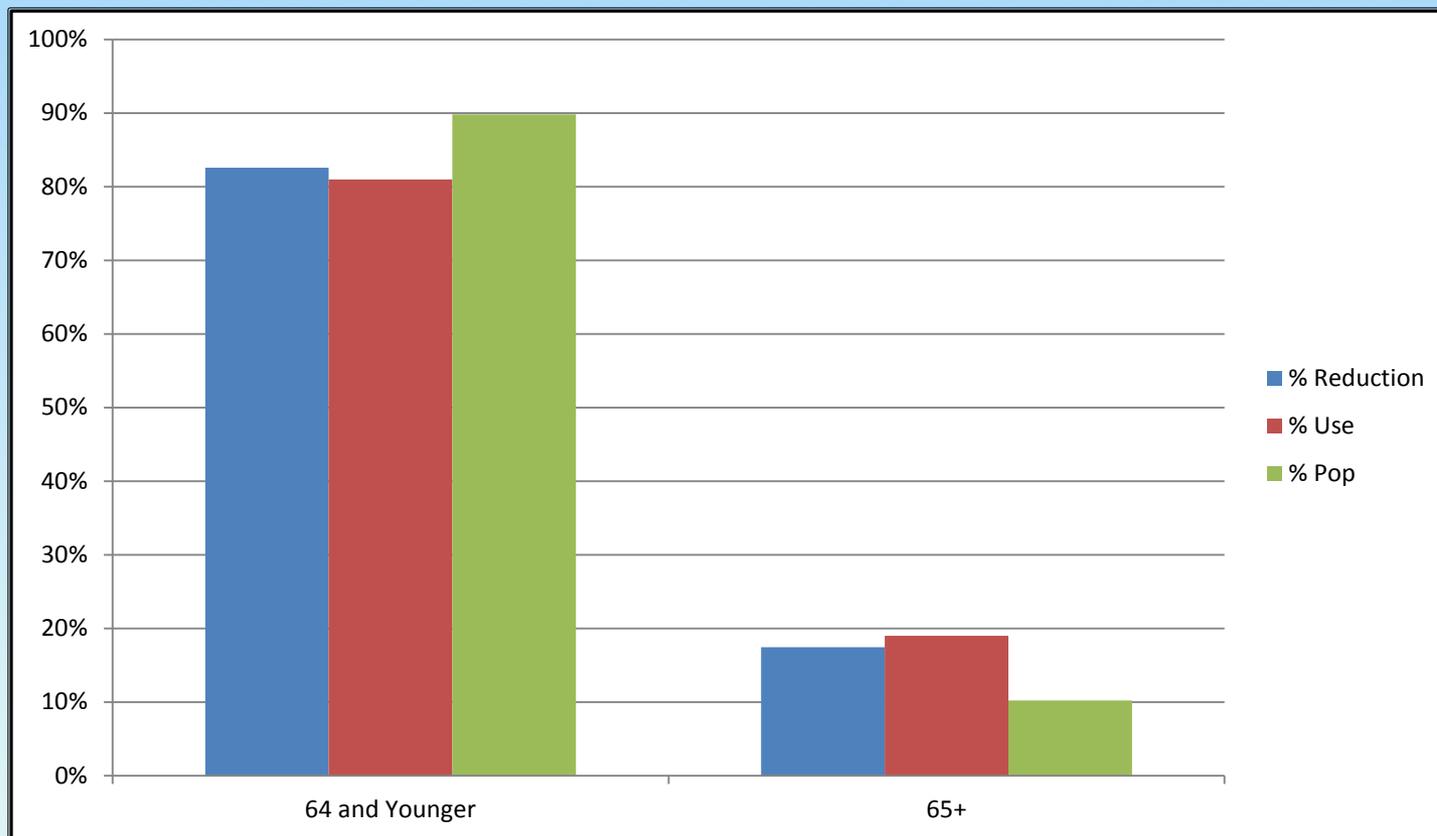
Results – by Male/Female

Share of Transit PHT Reduction and Usage
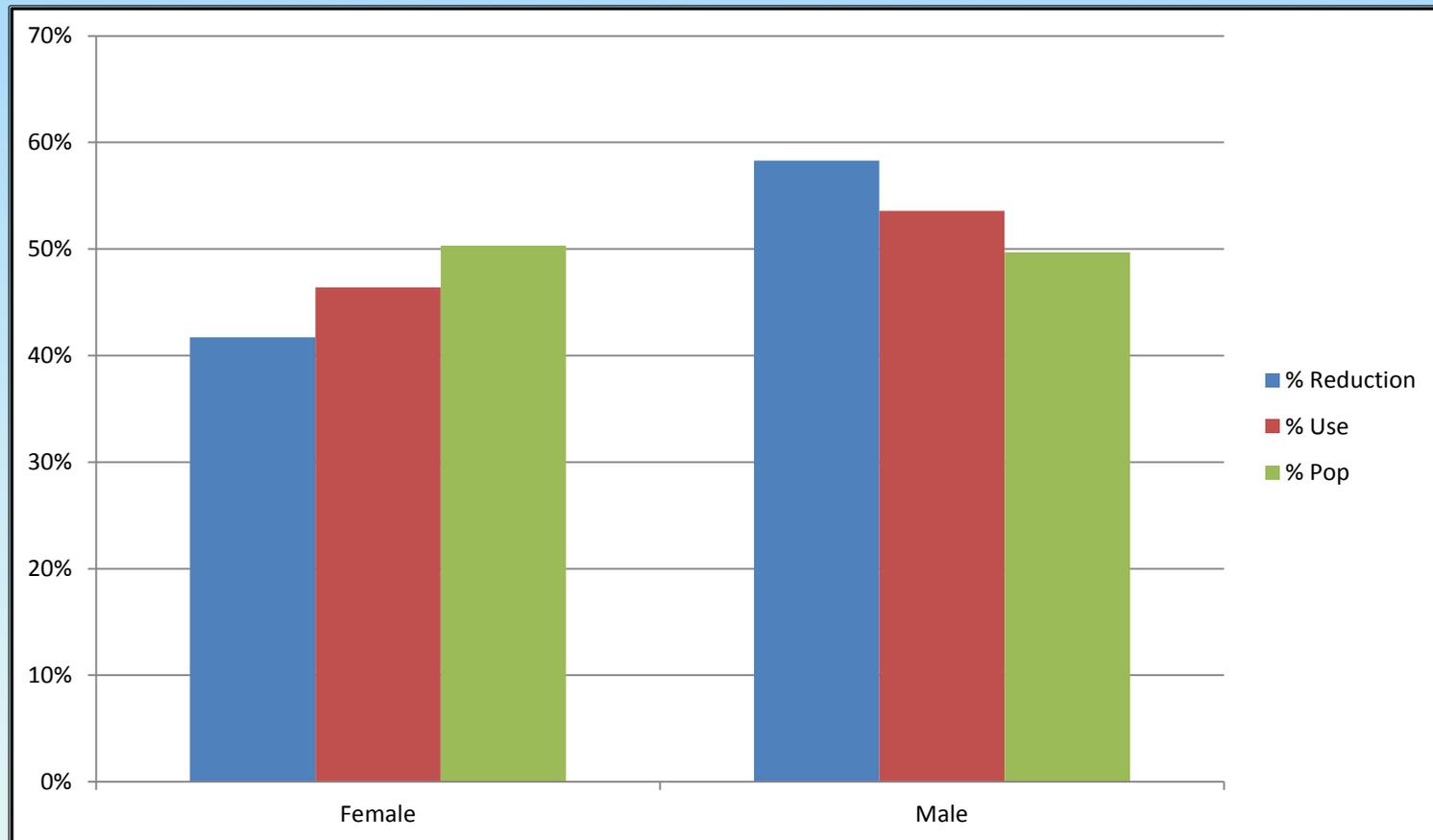
Summary

- This presentation shows that Activity-based Model can produce a good framework for environmental justice analysis.
- Future direction to use ABM on EJ analysis for:
  - Land Use Policies
  - Public Health
  - Active Transportation
  - Gentrification
  - Pricing

Thank you!

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